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Three makes of telefacsimile equipment are described and compared (1) Xerox Magnavox Telecopier, (2) Datafax 1824 and Dial/Datafax, and (3) Alden II Docufax. The models described are thought to be potentially useful to libraries, specifically for the purpose of transferring copies of printed pages from one library to another. Each system is capable of operating at minimum cost by using a single voice-grade telephone line. In this report the operating principles and characteristics of each model are described and the reliability and copy quality assessed. Costs are compared and tabulated for equipment, supplies, and telephone line service in two hypothetical library systems, one comprising two libraries and the other, ten libraries. It is concluded that all three of these makes of equipment perform with sufficient reliability and copy quality for most library purposes. The type of equipment to select for a specific library application is determined primarily by the anticipated volume of use, the quality and capacity of telephone lines to be used, and the nature of the material to be transmitted. (Author/CH)

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EQUIPMENT FOR FACSIMILE TRANSMISSION BETWEEN LIBRARIES: A DESCRIPTION AND COMPARATIVE EVALUATION OF THREE SYSTEMS

by

R. G. Morehouse

A STUDY PREPARED FOR

COUNCIL ON LIBRARY RESOURCES, INC.
(CLR-814)

December 29, 1967

UNIVERSITY OF NEVADA LIBRARY
RENO, NEVADA

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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ABSTRACT

Three makes of telefacsimile equipment are described and compared:

1. Xerox Magnavox Telecopier
2. Datafax 1824 and Dial/Datafax
3. Alden II Deskfax

The models described are thought to be potentially useful to libraries, specifically for the purpose of transferring copies of printed pages from one library to another. Each system is capable of operating at minimum cost by using a single voice-grade telephone line.

Operating principles and characteristics are described. Reliability and copy quality are assessed. Costs are compared and tabulated for equipment, supplies, and telephone line service in two hypothetical library systems, one comprising two libraries and the other, ten libraries.

It is concluded that all three of these makes of equipment perform with sufficient reliability and copy quality for most library purposes.

The type of equipment to select for a specific library application is determined primarily by the anticipated volume of use, the quality and capacity of telephone lines to be used, and the nature of the material to be transmitted.

A preliminary cost study can furnish a reasonably accurate prediction of cost per page for any proposed telefacsimile application. The decision can then be made as to whether the rapid service provided by a telefacsimile system is valuable enough to justify its cost.

I. BACKGROUND

This report is to some degree a sequel to the report on the Xerox Magnavox Telecopier,[1] published last year. The 30-day trial of this equipment, funded by the Council on Library Resources, yielded a considerable amount of useful information both on the capabilities and limitations of the hardware, and on the general value and applicability of telefacsimile toward accomplishing inter-library transfers of periodical articles.

The unexpended balance of the grant funding the above-mentioned experiment has been applied to further investigations, on a somewhat limited scale, of other makes of telefacsimile equipment which are comparable in cost, speed, and resolution to the Xerox Telecopier.

These investigations included observations of the telefacsimile project being conducted by the New York State Library utilizing primarily Datafax equipment, and demonstrations of Alden equipment at the Alden Research Center, Westboro, Mass. In addition, working installations of Datafax equipment were inspected at the Western Airlines headquarters at Los Angeles International Airport and at the American Broadcasting Corporation's offices and studios in Hollywood, California.

This report provides rudimentary comparisons of the Xerox Telecopier, Datafax, and Alden equipment in terms of general operating principles, cost, speed, reliability, and copy quality.

000. [illegible]

A. [illegible]

[illegible] electrosensitive devices operating on the [illegible] [illegible] of persistence and exist which [illegible] [illegible] to accomplish [illegible] [illegible] to common.

The basic speed of transmission for these [illegible] [illegible] is one minute for one $8\frac{1}{2}'' \times 11''$ page, or a scanning frequency of 60 lines per inch. Each model utilizes a rotary scanning device which examines a [illegible] of light reflected from the page to be copied, a narrow strip at a time. The light and dark areas reflected from the black ink of the printed characters and the white spaces between them generate varying intensities in the light beam, which is focused onto a photo-multiplier connected to an electronic system where it is converted into a correspondingly varying electrical signal. This signal is carried through a telephone line to the receiving (printing) device at a remote location. The receiver, or printer, has a rotary device synchronized with that of the transmitter, and converts the electrical signal into a permanent image on paper by printing one narrow strip at a time corresponding to the strips being scanned by the transmitter. The printing is accomplished by a mechanical stylus and carbon paper or the [illegible] [illegible]. The Datafax and Xerox printers both employ an electro-chemical printing technique.

Each of the three systems is capable of transmitting over a single 3KC (voice-grade) telephone line.

B. Mechanical Features and Operating Principles of Each System

1. The Xerox Magnavox Telecopier

This machine is described in considerable detail in the University of Nevada report published last year.[illegible] To recapitulate briefly, the important features of this system are listed below:

a) One physical unit is used both as a transmitter (scanner) and a receiver (printer), the only other separate component being the telephone coupler, a small separate unit plugged into the transmitter and used for both sending and receiving copy.

b) The only connecting link between stations is an ordinary telephone. No Dataphone, interfacing equipment, or other special installation procedure is required.

c) The printing is performed by a stylus pressing on carbon paper, activated by electrical signals converted from the light and dark impulses picked up by the remote scanner. Ordinary white paper is used.

d) After each copy is received, an operator must reload the machine with a fresh piece of paper (carbon set) to prepare to receive the next page.

2. The Datafax 1800 Series and Dial/Datafax

Several different Datafax models are available, all of similar design and cost, but differing in speed and/or resolution. The 1800 Series and the Dial/Datafax operate at the

[illegible]

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(d) [illegible]

(e) [illegible]

[illegible]

(a) [illegible]

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(c) [illegible]

(d) [illegible]

(e) [illegible]

(f) [illegible]

(g) [illegible]

(h) [illegible]

(i) [illegible]

(j) [illegible]

(k) [illegible]

(l) [illegible]

(m) [illegible]

(n) [illegible]

(o) [illegible]

(p) [illegible]

(q) [illegible]

(r) [illegible]

(s) [illegible]

(t) [illegible]

(u) [illegible]

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(y) [illegible]

(z) [illegible]

(aa) [illegible]

(bb) [illegible]

(cc) [illegible]

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(iiiii) [illegible]

(jjjjj) [illegible]

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(lllll) [illegible]

(mmmmm) [illegible]

(nnnnn) [illegible]

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manufacturer offering speeds of 3.0 and 1.2 minutes per copy at 96 LPI, depending upon the capacity of the connecting link (number of voice-grade telephone line equivalents used at the same time). The greater the telephone line capacity used, the higher the cost per month will be.

Another Datafax option available is a model transmitting an 8½" x 11" page in 5.3 minutes at a resolution of 133 LPI. This system, as with the higher speed systems, requires a private or leased line, higher than voice-grade (in this case, a 3KC conditioned channel, sometimes called "4KC", or a "Schedule II Telephoto Circuit"). This higher resolution makes this system potentially useful for transmission of library materials printed in smaller than 8-point type faces.

3. The Alden 11 Docufax

This system has the capability of transmitting and receiving at two different resolutions, 96 LPI or 166 LPI, and at two different speeds, 6 minutes or 3 minutes per page at 96 LPI, and about 10.5 or 5.2 minutes per page at 166 LPI. The higher speed can be used only where the telephone line is of relatively high quality, as with a conditioned 3KC leased line. The speed and/or resolution can readily be switched from one setting to the other by the operators.

In actual practice, speeds in terms of minutes per page can be somewhat faster than the nominal rates with this system.

The configuration of the scanning device is such that the operator can usually avoid using machine time to transmit blank side margins of a page. Pages may be scanned either from top to bottom or sideways.

Another capability of the Alden II is the enlargement of copy being received. That is, the receiver and scanner can be set so that the copy being received is blown up to four times original size. This greatly improves legibility, and appears useful in cases involving small print or poor original copy quality.

IV. RELIABILITY

It is not possible to accurately assess the reliability of any of these telefacsimile devices without conducting full-scale tests over a considerable period of time. However, it can be said that each of the three systems appears to have achieved a satisfactory level of reliability at this time. This statement is based on information obtained from written reports by agencies using the equipment, letters from users, conversations with operators of the equipment and with administrators involved with various applications of telefacsimile systems, and from some personal observation.

It is possible to make a few comments about the factors affecting reliability with regard to each of these systems.

A. Reliability of transmitters and receivers

1. Xerox Magnavox Telecopier

The test of this equipment performed last year at the University of Nevada was conducted with some of the first units off the assembly line of this relatively new product. Hence, the reliability problems encountered then can be largely attributed to the sort of faults that appear in any new, complex device before all the bugs have been worked out of it.

The manufacturing of the Telecopier, formerly handled by the Magnavox Corporation, has now been taken over by the Xerox Corporation, which reports numerous improvements affecting reliability.

A report recently received from the South Carolina State

Library Board[6] describing a three-month test using the equipment involving three libraries, indicated absolutely no reliability problems. Although this test evidently entailed a relatively low volume of use over this period, it does tend to confirm the impression that the Telecopier is now sufficiently reliable for regular inter-library use.

The Xerox Corporation conducts an extensive training program to ensure that technicians are available in most areas to service this equipment.

B. Datafax

The Datafax is manufactured, marketed, and serviced by Stewart-Warner Electronics and is also marketed and serviced by the Dictaphone Corporation.

Having been on the market for a number of years, the Datafax has proven its reliability to be satisfactory. This writer has observed installations in the airline and television industries where Datafax equipment is in daily use, performing essential communication functions between stations at various distances.

The widespread availability of Dictaphone and Stewart-Warner technicians is another important reliability factor.

One interesting observation made by a Datafax technician was to the effect that a high percentage of malfunctions are caused by persons operating the equipment who attempt to adjust it or otherwise tamper with it. This is analogous to

someone attempting to adjust a television set and getting it all out of kilter when the picture is originally poor only because of adverse weather conditions or problems at the transmitting end.

B. Alden

The Alden equipment has also been manufactured for a number of years, and its reliability is evidenced by the fact that it is regularly used by U. S. Weather Bureau and Federal Aviation Agency stations throughout the country. Technicians are widely available to service these systems.

The helix on the Alden Recorder is mounted in a resilient, rather than a rigid fashion, and the electrode (corresponding to the fixed silver alloy printer bar on the Belafax) is mounted so that it is in motion rather than stationary while the machine is printing. These factors are claimed by the manufacturer to provide increased reliability in the form of more even wear and more consistently high copy quality.

Other Alden models are also available, offering higher speeds, but using wider band-width (more expensive) telephone line connections.

B. Reliability of Telephone Lines

The connecting link between telefacsimile stations, generally some sort of telephone line or lines, is a key factor in the performance of these systems. How this factor relates to each of the

three systems described in this report is outlined briefly below:

8. Voice Response Telescriber

This unit is designed and advertised to operate over any ordinary telephone, using a normal voice-grade line to any other ordinary telephone where there is a Telescriber available. This is indeed an advantage in terms of flexibility, portability, and cost of use.

Ordinary telephone lines, however, especially at long distances, are subject to vagaries of quality, as anyone who has ever experienced a "bad connection" can testify. A weak, unbalanced, or noisy line can have an adverse effect on quality of copy received and can in fact render the Telescriber, or any other telefacsimile device, ineffective.

Experience at the University of Nevada has shown that a telephone connection of at least average quality will result in adequate performance of the Telescriber. If a bad connection is obtained, often a better quality signal can be had by simply hanging up the telephone and then re-dialing the number, thus obtaining a different line.

The Telescriber can, of course, be used in conjunction with a Datephone. This will at least insure a high-quality or "conditioned" line from the Telescriber to the local telephone switching station. Also, between two stations where volume of use justifies the expense, a leased line can be

used. Such a line can be conditioned, where necessary, to ensure high quality performance and reliability.

B. Datafax

In general, Datafax systems are designed to operate with leased or "dedicated" lines, connected directly to the telefacsimile equipment. This tends to reduce telephone line problems to a minimum.

The Dial/Datafax is designed to operate through a Datephone, and may thus be connected by dialing through ordinary public telephone lines to any other station, near or far, which is similarly equipped. This model is, therefore, subject to telephone line difficulties when such lines are used.

C. Alden

The Alden systems are similar to Datafax in that they are designed primarily for use over dedicated lines. However, using a Datephone, the Alden equipment can also utilize ordinary public telephone lines.

If telephone line problems are experienced, the Alden equipment has the advantageous capability of switching to increased resolution (from 96 LPI to 196 LPI) to improve copy quality. Also, if the telephone line performance is very good, the higher speed setting can be used. If line quality drops, the speed can be reduced to the lower setting.

V. COPY QUALITY

In general, all systems operating at 96 LPI, when functioning well, in good adjustment, and experiencing no telephone line problems, provide adequate legibility for most library materials. Type fonts smaller than 8-point are usually illegible. 10-point type tends to be of borderline legibility, and the legibility suffers considerably if any maladjustments or line problems occur.

The equipment capable of higher resolution (Datafax 2000 at 200 LPI and the Xidex 11 at 288 LPI) offers better copy quality, but with higher telephone line capacity requirements, and hence higher costs or lower speeds.

The Xerox Magnavox Telecopier provides a black image (from carbon paper) on ordinary white paper. The Datafax and Xidex systems provide a dark but slightly brownish image on chemically treated paper which is of adequate quality, although not perfectly smooth.

Original copy of low contrast, such as a faint-than-average Xerox copy, may not always be successfully transmitted over any of these systems.

Each of the three systems is capable of reproducing half-tones with some degree of fidelity, but photographs transmitted are not generally of very satisfactory quality.

VI. COSTS

A. General

There are many factors which enter into determining the cost of any telefacsimile service. Among these are volume of use, number of stations, distances between stations, type and capacity of telephone line(s) or other connecting links, requirements for interfacing equipment, speed requirements, resolution requirements, make of equipment selected, whether one-way service only or transmitting and receiving in both directions are required, whether cost of the connecting link can be shared with other functions, plus various factors affecting labor and administrative overhead costs.

B. Labor

Labor and administrative costs cannot be accurately computed within the scope of this study. Therefore, they are omitted from consideration here. It appears that labor costs will not differ greatly between these systems, with the exception that the Xerox Magnavox Telecopier requires more operator time at the receiving end to load a fresh sheet of paper after each page is received. The Datafax and Alden printers receive automatically, with little operator attention. For all systems, labor costs can be estimated to be on the order of 20% to 40% of total costs with a reasonably high volume of use. Expressed in terms of percentage of total costs, labor costs drop rapidly as volume of use decreases, and increases rapidly as volume of use increases. Expressed in

of the two larger libraries. Fifty of these are transmitted from one large library to the other; the remaining 100 are transmitted over long-distance telephone lines via direct-distance dialing from a large library to one of the smaller ones. This telephone service is billed on an intra-state WATS basis, at a total flat monthly rate of $700.

As envisioned here, each small library is arbitrarily assumed to have one receiver only and each larger library one transmitter and one receiver (or one transceiver only, in the case of the Telecopier). In actual practice, the amount of equipment installed in each location would be geared to the volume of use experienced there, in order to avoid unacceptable delay times during peak periods of use.

Costs for this network are shown in Table II.

VII. CONCLUSIONS

The conclusions listed below are not based on the sort of complete, accurate, first-hand information which would be generated by actual testing and use of all of these machines in libraries. They are based on data supplied by the manufacturers, some informal written and verbal reports from library experimenters, observations of this equipment in action, conversations with people who are using the equipment, and experience in library applications of telefacsimile gained from the 30-day test of the Xerox Magnavox Telecopier[5] performed last year.

1. Speed

All three systems, in the models described here, operate at the same nominal speed of one 8½" x 11" page each 6 minutes. However, an exception is to be noted in that the Alden II can also be switched to operate at a higher speed where telephone line capabilities are high enough to accommodate it (one 8½" x 11" page each 3 minutes).

2. Resolution and copy quality

All three systems operate at the same resolution of 96 lines per inch. Again, the Alden II provides an exception in that it can be switched to 100 LPI when desirable because of poor original copy quality or fine print. The resolution of 96 LPI seems adequate with any of the three makes for 9-point or larger type faces when all is working well. For 8-point or smaller, a higher resolution is usually required.

Diesem Sinne soll die Bibliothek systematisch alle neue wissenschaftliche Literatur sammeln, bibliographisch erfassen, und benutzbar machen. Die Bibliothek soll auch alte wissenschaftliche Literatur sammeln, soweit sie für die Benutzer von Interesse ist. Die Bibliothek soll auch Literatur sammeln, die für die Geschichte der Wissenschaften wichtig ist.

B. Zugänglichkeit

Diese Ziele verfolgend, soll die Bibliothek für möglichst viele Benutzer zugänglich sein. Die Zugänglichkeit der Bibliothek soll durch folgende Massnahmen gefördert werden:

Die Zugänglichkeit der Bibliothek soll durch Öffnungszeiten gefördert werden, die den Bedürfnissen der Benutzer angepasst sind. Die Bibliothek soll auch Literatur ausleihen, soweit dies mit ihren Aufgaben vereinbar ist.

C. Dienste

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Dienste für Benutzer

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200 PAGES PER MONTH

Xerox Magnavox Telecopier .... $0.88 per page

Datafax 1024 .... $1.088 " "

Alden 11 Dexafax .... $1.06 " "

500 PAGES PER MONTH

Xerox Magnavox Telecopier .... $0.44 per page

Datafax 1024 .... $0.432 " "

Alden 11 Dexafax .... $0.54 " "

1,000 PAGES PER MONTH

Xerox Magnavox Telecopier .... $0.27 per page

Datafax 1024 .... $0.201 " "

Alden 11 Dexafax .... $0.37 " "

Total costs per page transmitted may vary from as low as 20 cents up to several dollars per page, depending primarily on volume of use and distance between stations.

6. Feasibility for General Library Use

It is now possible to estimate telefacsimile costs with reasonable accuracy for a specific volume of use in any specified network of two or more stations. If any library or library system

can predict its volume of use in a projected telefacsimile network, and thus predict its cost per page transceived, it then remains to decide whether the value of the service is worth the cost. The importance of rapid service will vary greatly from one situation to another.

Telefacsimile service is feasible and available for inter-library use today in any library situation where such rapid service is valued highly enough to justify the cost.

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[illegible]

[illegible]

[illegible]:	[illegible] Corporation
[illegible]:	11" high, 18" wide, 15" long
[illegible]:	46 pounds
[illegible]:	110 volts, AC
[illegible]:	Standard telephone handset, rotary voice-grade telephone line.
[illegible]:	Up to 8 3/8" wide by any length single sheets, any color.
[illegible]:	Same size as input page, black and white, with half-tones. Carbon copies, 1 to 3 copies with each transmission.
[illegible]:	60 lines per inch (previously adequate for 8-point type or larger).
[illegible]:	180 lines per minute
[illegible]:	6 minutes per 8½" x 11" sheet 1,800 lines per minute (especially economical on pages, any width up to 8 3/8").
[illegible]:	Lease at $50 per month per machine, including 600 minutes operating time. Each additional minute, as required up to 6 hours, is billed at $0.100.

APPENDIX 13

SPECIFICATIONS, SATURN 1000

Manufactured by:	Primate Human Electronics
Marketed by:	Primate Human Electronics and Intergalaxy Enterprises
Size:	
Dimensions:	18[1] wide, 10[1] high, 18[1] deep
Keyboard:	16 5/8[1] wide, 10[1] high, 18[1] deep
Weight:	
Dimensions:	97 pounds
Keyboard:	78 pounds
Power Supply:	115 Volt, 60 Hz (All components and circuitry are supplied by a separate power source, therefore may have to be synchronized by using a Primate Human Standard Frequency Power Supply unit or wall receptacle).
Environmental Limits:	100 centigrade kilo, minimum or higher. Disk capability or deviation to maximum kilo, a temperature high enough to cook or melt plastic.
Input Signal:	5[1] volts, straight electric, any length, any color.
Output Signal:	5[1] volts by any length, black and white wide band video.
Resolution:	80 lines per inch.
Scanning Rate:	100 lines per minute.
Production Speed:	8 minutes per 5[1] x 7[1] sheet.
Disk Assembly (when ordered):	
Diameter:	8 1/2
Density:	8 SD
Cartridges (if required):	8 SD ea. (approx.)
Power Supply (if required):	8 SD ea. (approx.)

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